Finite-difference models with an internal water-bottom boundary condition

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Project objective

Modify the computer elastic model program to allow a water layer above the elastic layers, allowing simulated output from a physical model and deep marine models.

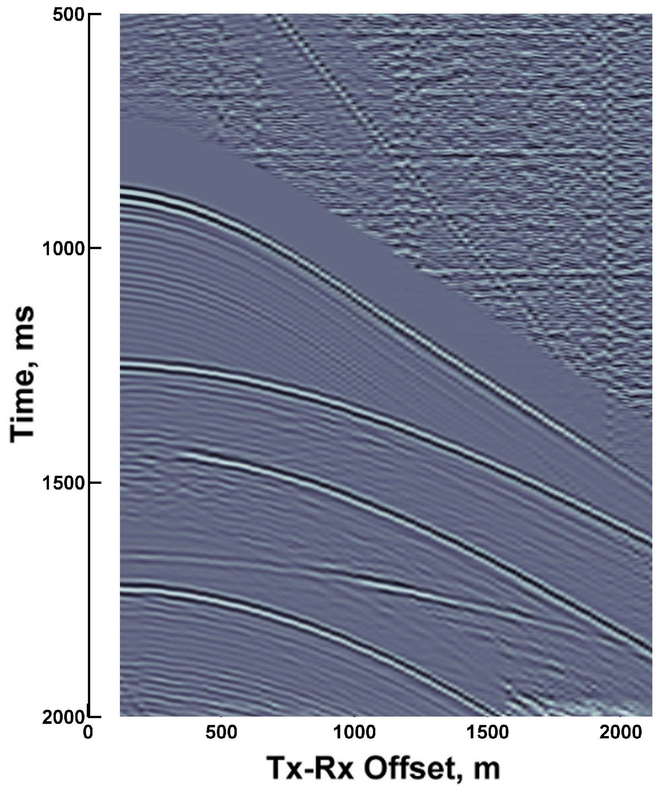

Figure 1: Physical model with a 200 ms AGC. The most obvious difference from the computer model is the complete conversion of the first primary reflection into a head wave beyond 1000 metres.

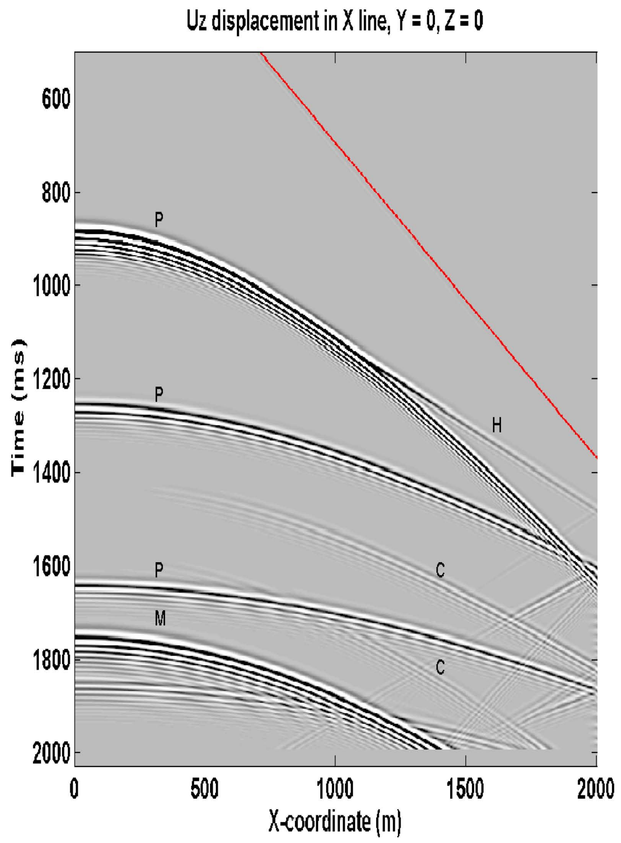

Figure 2: Computer model with parameters of the layers approximately the same as those from the physical model. Primaries are marked P, a multiple is marked M, a head wave is marked H, and converted wave events, reconverted, are marked C. The numerical dispersion is very noticeable.

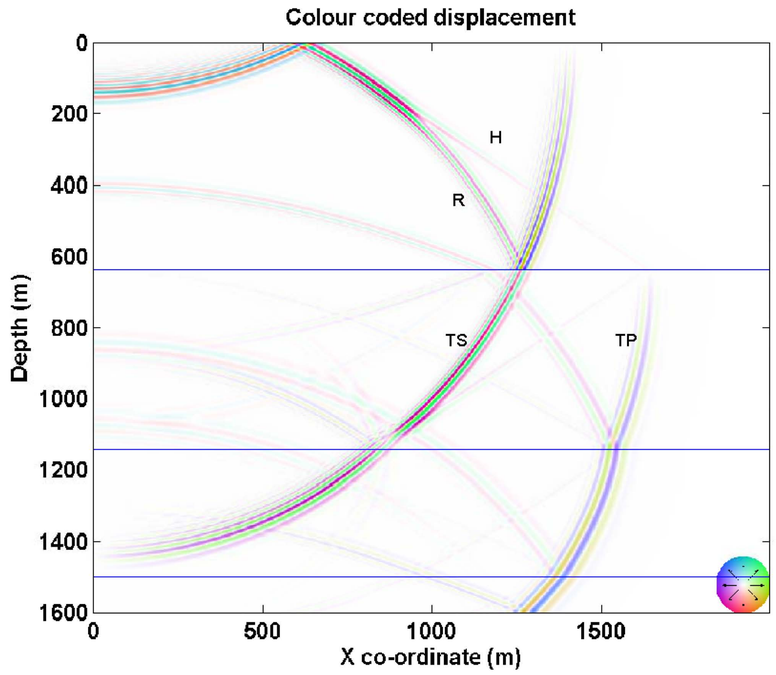

Figure 3: A snapshot of the computer model showing the wave fronts that will appear at the surface in Figure 2. R is the reflected wave, H is the head wave, TS is the transmitted shear wave, and TP is the transmitted pressure wave. The head wave has lower amplitude than the reflected wave, possibly because the water velocity is near the elastic shear velocity, causing the waves to couple.

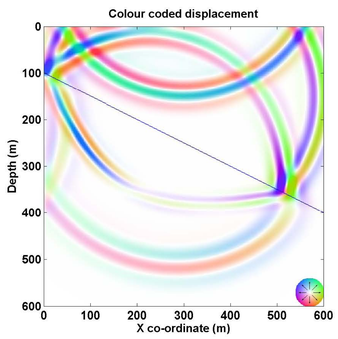

Figure 4: A snapshot of wave fronts from an explosive source in the water zone above the boundary sloping to the right. Above the boundary the wave fronts are simple arcs which were reflected from the surface and the boundary itself. Below is the elastic zone where the waves are split into shear (slower) and pressure (faster).

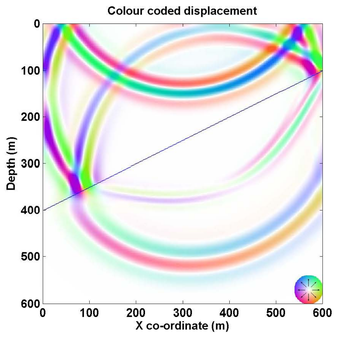

Figure 5: A wave fronts snapshot as in Figure 3, but with the boundary slope down to the left. The slope here is 50%.

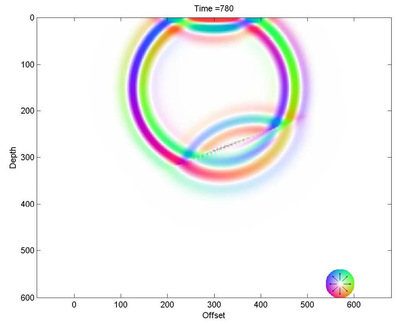

Figure 6: A wave fronts snapshot as in Figure 4, but with a slope of 37%. With this slope instability begins to appear along the boundary which will gradually dominate the plot.

Conclusions

The ability to make direct comparisons between computer models and physical models may make valuable contributions toward quality control and modeling enhancements.

Computer simulation of the water bottom boundary condition is worthwhile, but needs more effort to be reliable.

The large velocity contrast between water and elastic pressure waves will require more work on correction algorithms to reach an acceptable level of dispersion.